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(54) Title of the Invention CLEANING METHOD OF SEMICONDUCTOR SUBSTRATE AND CLEANING DEVICE USED FOR THE SAME

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Specification

1. Title of the Invention

CLEANING METHOD OF SEMICONDUCTOR SUBSTRATE AND CLEANING DEVICE USED FOR THE SAME

2. Scope of Claims

(1) A cleaning method of a semiconductor substrate, wherein cleaning is performed by causing the inside of a processing tank, in which a semiconductor substrate is housed, to be in a pressure-decreased state, supplying a cleaning fluid to the inside of the processing tank to cause the substrate, in which concave portions are formed, to be immersed in the cleaning fluid, and applying ultrasonic vibration processing to the semiconductor substrate and the cleaning fluid in order to cause gas remaining in the concave portions to be discharged.

(2) A cleaning device for a semiconductor substrate, comprising:

a processing tank in which a semiconductor substrate is to be stored, and which can be sealed;

a cleaning fluid supply means which supplies a cleaning fluid to the inside of the processing tank;

ultrasonic wave generation means which is provided inside the processing tank, and which provides ultrasonic vibrations to the cleaning fluid; and

pressure decrease-increase means which makes adjustment to cause the inside of the processing tank to be in any one of a pressure-decreased state and a pressure-increased state.

3. Detailed Description of the Invention

[Field of the Industrial Applicability]

[0001] The present invention relates to a cleaning method of a semiconductor substrate for cleaning a semiconductor substrate in which concave portions are formed, and to a cleaning device used for the same.

[Prior Art]

[0002] In recent years, along with high integration and minimization of semiconductor integrated circuits, a circuit pattern formed on a semiconductor substrate (hereinafter,

simply referred to as "wafer") has been also minimized, and a structure thereof has also become complicated. Accordingly, techniques for forming concave portions on a wafer and then forming elements in the portions have been adopted.

[0003] Additionally, with an advance in high integration and minimization, extraneous matters attached to a wafer, or the like, which were not regarded as problems in the past, have become apparent as serious problems because of characteristics thereof.

[0004] For this reason, it needs to be ensured that attached extraneous matters or the like are removed by cleaning processing. The cleaning processing is performed in processing after edging for forming the concave portions, in processing for removing oxide formed on a wafer, or the like.

[0005] Fig. 4 is a view showing a schematic configuration of a cleaning device with which conventional cleaning processing of this kind is performed. In the view, reference numeral (1) denotes a cleaning tank in which cleaning is performed; (3), a cleaning fluid supplied to the inside of the cleaning tank (1); (4), a wafer processed by being immersed in the cleaning fluid (3); and (11), a wafer supporting table which is provided inside the cleaning tank (1), and on which wafer (4) is mounted.

[0006] Next, descriptions will be provided for a cleansing method by use of the cleansing device configured as described. First, the cleaning fluid (3) is supplied to the inside of the cleaning tank (1), and is filled in the cleaning tank (1) so that the cleaning fluid (3) reaches a predetermined height in the cleaning tank (1). Thereafter, the wafer (4) is transferred to the cleaning tank (1) and is mounted on the wafer supporting table (11). The processing on the wafer (4) is performed by immersing the wafer (4) in the cleaning fluid (3) in this manner. In this regard, usually, the cleaning fluid (3) is set to circulate. Cleaning of the wafer (4) is performed in this manner. In the wafer (4), trenches (5) which are concave portions are formed as shown in Fig. 5. This trench (5) is formed, for example, in order that an opening thereof has a surface size of 1μm×1μm, and that a depth thereof of is approximately 5μm.

[0007] As a matter of course, in addition to the cleaning of the main surface part of the wafer (4), the cleaning of the inside of the trench (5) is also required.

[0008] Incidentally, in addition to the cleaning method using the circulation, in order to

improve the efficiency of the cleaning, as a cleaning method of the wafer (4), a cleaning method, in which ultrasonic waves are applied to the cleaning fluid (3) and the wafer (4) and the cleaning fluid (3) is pressurized, has been also used. Further, a method, in which after the wafer (4) is mounted on the wafer supporting table (11), pressure decreasing is carried out for the cleaning tank (1), and in that state, the wafer (4) is cleaned by supplying the cleaning fluid (3), has been used as well.

[Problems to be Solved by the Invention]

[0009] The conventional cleaning methods have been as described above and have been ones in which the cleaning of the inside of the micro trench (5), which is formed on the wafer (4) and has a surface size of 1μm×1μm at the opening thereof and a depth of approximately 5μm, is not perfectly performed.

[0010] In other words, as shown in Fig. 5, even if the cleaning fluid (3) is supplied to the wafer (4) in which the trenches (5) are formed, gas (6) remains in the trenches (5), and the cleaning fluid (3) does not entirely reach the surface in the trenches (5).

[0011] This is because since the opening size of the trench (5) is extremely small, it is difficult for the cleaning fluid (3) to be caused to enter into the inside of the trenches 5 due to the surface tension thereof, and it is difficult to replace the residual gas (6) in the trenches (5) with the cleaning fluid (3) by means of a method such as the ultrasonic method or the pressure increase-decrease method. Accordingly, there has been a problem that, with the conventional methods, cleaning is not performed over the bottom in each of the trenches (5), and accordingly extraneous matters can not be completely removed and remain, resulting in the deterioration of the reliability.

[0012] The present invention is made to solve such above-described problems. The object of the present invention is to obtain a cleaning method of wafer, which is performed in a way that a cleaning fluid is spread over the inside of concave portions formed in wafer in order to perform preferred cleaning to attempt improvement in quality thereof, and to obtain a cleaning device used for the method.

[Means for Solving the Problem]

[0013] A cleaning method of a semiconductor substrate according to the present invention is one in which cleaning is performed in the following manner. Specifically, a

pressure-decreased state is set inside a processing tank in which a substrate is housed, and a cleaning fluid is supplied to the processing tank in order that the substrate in which concave portions are formed is immersed in the cleaning fluid. Thereafter, ultrasonic vibration processing is applied to the substrate and the cleaning fluid to cause gas remaining in the concave portions to be discharged.

[0014] In addition, a cleaning device according to the present invention includes: a processing tank which can be sealed, and in which a substrate is to be stored; cleaning fluid supply means which supplies a cleaning fluid to the inside of the processing tank; ultrasonic wave generation means which is provided inside the processing tank and gives ultrasonic vibrations to the cleaning fluid; and pressure decrease-increase means which makes adjustment in order that a pressure-increased state or a pressure-decreased state is set inside the processing tank.

[Effect]

[0015] In the invention, the processing tank is set to be in a pressure-decreased state by the pressure decrease-increase means, and then the cleaning fluid is supplied from the cleaning fluid supply means. Accordingly, the cleaning fluid is caused to reaches vicinities of the bottoms of the concave portions formed in the substrate. Further, in that state, the ultrasonic wave generation means is operated, and the ultrasonic processing is applied to the substrate through the cleaning fluid. Consequently, the gas remaining at the bottoms of the concave portions becomes bubbles, and thus is discharged into the cleaning fluid, or into a predetermined space portion inside the processing tank, whereby the cleaning fluid is spread to the entire surface of the concave portions. In this manner, it becomes possible to clean the inside of the concave portions to have a desired state thereof, by use of the cleaning fluid.

[Example]

[0016] Hereinafter, descriptions will be provided for an example of the present invention. Fig. 1 is a view showing a schematic configuration of a cleaning device of the example of the present invention. In the figure, reference numeral (10) denotes a cleaning tank; (11), a wafer supporting table provided to the bottom of the cleaning tank (10); (12), a carrying in/out door which is formed on a side part of the cleaning tank (10),

and which can be opened/closed and can be watertight; and (13), an ultrasonic transducer (hereinafter, referred to as "transducer") which is provided on the upper part of the cleaning tank (10) so as to face the wafer supporting table (11). Reference numeral (14) denotes a cleaning fluid supplying pipe in which tip portion thereof is inserted through the upper part of the cleaning tank (10); (15), a valve provided to a path of the cleaning fluid supply pipe (14); and (16), a pressure increase-decrease unit which is inserted through the upper part of the cleaning tank (10), and which is provided so as to face the cleaning fluid supply pipe (14). Reference numeral (17) denotes a discharging pipe provided to the bottom of the cleaning tank (10); and (18), a discharging valve provided in the path of the discharging pipe (17).

[0017] Next, descriptions will be provided for a method of cleaning the wafer (4) by use of the cleaning device configured as described.

[0018] First, the carrying in/out door (12) is set to be in an opened state, the wafer (4) is transferred to the inside of the processing tank (10), and the wafer (4) is mounted on the wafer supporting table (11). In this wafer (4), trenches (5) are formed, and the wafer (2) is mounted on the wafer supporting table (11) so that a main surface thereof, in which the trenches (5) are formed, faces the upper side of the processing tank (10). After the carrying in/out door (12) is set to be in the opened state, the pressure increase-decrease unit (16) is operated in order to decrease the pressure inside the processing tank (10) to a predermined pressure. In this respect, the valve (15) and the discharging valve (18) are kept in a closed state. Thereafter, the valve (15) is opened to supply the cleaning fluid (3), for example, purified water, to the inside of the processing tank (10). This cleaning fluid (3), as shown in Fig. 2, is supplied so that a part of the transducer (13) is immersed, and then the valve (15) enters the closed state. Subsequently, the pressure increase-decrease unit (16) is operated in order to return the pressure inside the processing tank (10) to the atmospheric pressure. Accordingly, in a space portion in the processing tank (10), the pressure-decreased state turns to the pressure-increased state, whereby the cleaning fluid (3) enters into the inside of the trenches (5).

[0019] In this respect, in a case where, in the trench (5), the opening has a surface size of 1μm×1μm, and the depth thereof is approximately 5μm, when the pressure

decrease-increase unit (16) is operated to lower the pressure inside the processing tank (10) to be at 10mmHg to 100mmHg, and then is returned to the atmospheric pressure (760mmHg), the amount of the residual gas (6) occupies the portion of the trench (5), which has a height of approximately 0.06μm to 0.6μm from the bottom surface.

[0020] In this state, the amount of the residual gas (6) is approximately one eightieth to one eighth that in the conventional example (Fig. 3(a)).

[0021] Next, the transducer (13) is operated at a frequency of 75kHZ and an output of 0.2w/*cd* . Accordingly, cavitation (19) is caused in the cleaning fluid (3). Because of shock waves for extinction of the cavitation (19), the residual gas (6) inside the trenches (5) is gradually dispersed into the cleaning fluid (3), whereby scattering and diffusing thereof occur (Fig. 3(b)).

[0022] After the occurrence of the cavitation (19), after approximately two to three minutes passes, the gas (6) in the trenches (5) is extinct. By continuing this ultrasonic processing for a predetermined time, for example, for ten minutes, extraneous matters attached to the side walls and the bottom surfaces in the trenchs (5) are dispersed into the outside of the trenchs (5). Accordingly cleaning thereof is sufficiently performed (Fig.3(c)).

[0023] Thereafter, the discharging valve (18) is in the opened state, and the cleaning fluid (3) is discharged from the discharging pipe (17). The wafer (4) is transferred to the outside of the cleaning tank (10) from the carrying in/out door (12) to dry the wafer (4) by use of a drier.

[0024] When the cleaning processing of the wafer (4) is performed in this manner, removal of the extraneous matters attached to the inside of trenches (5) formed in the wafer (4) is effectively performed. By performing the cleaning processing in this way, it is possible to obtain one for which improvement in quality is attempted.

[0025] In the above-described example, the pressure inside the cleaning tank (10) is decreased and is returned to the atmospheric pressure after the cleaning fluid (3) is supplied thereto. However, note that even when the pressure inside the cleaning tank (10) is decreased and the cleaning tank (10) is in the pressure-decreased state as well without decreasing the pressure after the cleaning fluid (3) is supplied thereto, the

amount of the residual gas (6) is sufficiently smaller compared to that with the conventional method. In addition, when the pressure inside the cleaning tank (10) is decreased and then is increased to be higher than the atmospheric pressure after the cleaning fluid (3) is supplied thereto, it is possible to further reduce the amount of the residual gas (6) in the trenches (5) compared to the case where the pressure is returned to the atmospheric pressure after the cleaning fluid (3) is supplied thereto. In any of the cases, the same effect as the above-described example can be obtained.

[0026] Additionally, in the above-described example, the descriptions have been provided for the case where in the concave portion, the opening thereof has a surface size of 1μm×1μm and the depth thereof is approximately 5μm. However, it goes without saying that the present invention is also applied to the case where an opening size is more smaller and the depth is more larger and the similar effects as in the above-described case can be obtained.

[Effect of the Invention]

[0027] As described above, according to the present invention, it is possible to obtain one, in which concave portions formed in a substrate is sufficiently cleaned, and for which quality improvement is attempted, because the cleaning method in the following manner is adopted. Specifically, in the cleaning method, the inside of the processing tank, in which a substrate is housed, is set to be in the pressure-decreased state, and then the cleaning fluid is supplied to immerse the substrate in the cleaning fluid, and in this state, the ultrasonic vibration processing is applied.

[0028] In addition, the present invention includes an effect that favorable cleaning is performed to attempt improvement in quality, because the cleaning device includes: the cleaning fluid supply means which supplies the cleaning fluid to the processing tank in which the substrate is to be housed; ultrasonic wave generation means which gives ultrasonic waves; the pressure decrease-increase means which makes adjustment in order that the inside of the processing tank is in the pressure-decreased state of the pressure-increased state.

[Brief Description of the Drawings]

[0029] Fig. 1 is a cross-sectional view showing a schematic configuration of an

example of a cleaning device of an example of the invention; Fig. 2 is a cross-sectional view showing a state where a substrate is cleaned by use of the cleaning device shown in Fig. 1; Figs. 3(a) to 3(c) are cross-sectional views showing steps for cleaning the trench portions, which are essential portions of the substrate, by means of a cleaning method of the invention; Fig. 4 is a cross-sectional view showing a state where the substrate is cleaned using a conventional cleaning device; and Fig. 5 is a cross-sectional view of the essential part showing the state where the trench parts of the substrate are cleaned shown in Fig. 4.

[0030] In the drawings, reference numeral (3) denotes a cleaning fluid; (4), a wafer; (5), trench; (6), residual gas; (10), a cleaning tank; (13), a transducer; (14), a cleaning fluid supply pipe; (16), a pressure increase-decrease unit; and (19), cavitation.

[0031] Note that in the figures, the same reference numerals denote the same parts or equivalent parts.

Agent Masuo Oiwa

FIG. 1

10 CLEANING TANK

13 TRANSDUCER

14 CLEANING FLUID SUPPLY PIPE

16 PRESSURE INCREASE-DECREASE UNIT

FIG. 2

3 CLEANING FLUID

4 WAFER

16 PRESSURE INCREASE-DECREASE UNIT

FIG. 3

5 TRENCH

6 RESIDUAL GAS

19 CAVITATION

Amendment (Voluntary)

1990, January, 22

Examiner of JPO

1. Display of the Case Tokugan-hei 1-181025

2. Title of the Invention

CLEANING METHOD OF SEMICONDUCTOR SUBSTRATE AND CLEANING DEVICE USED FOR THE SAME

3. Applicant for amendment

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5. Objectives for Amendment

Section of Detailed Description of the Invention in the Specification

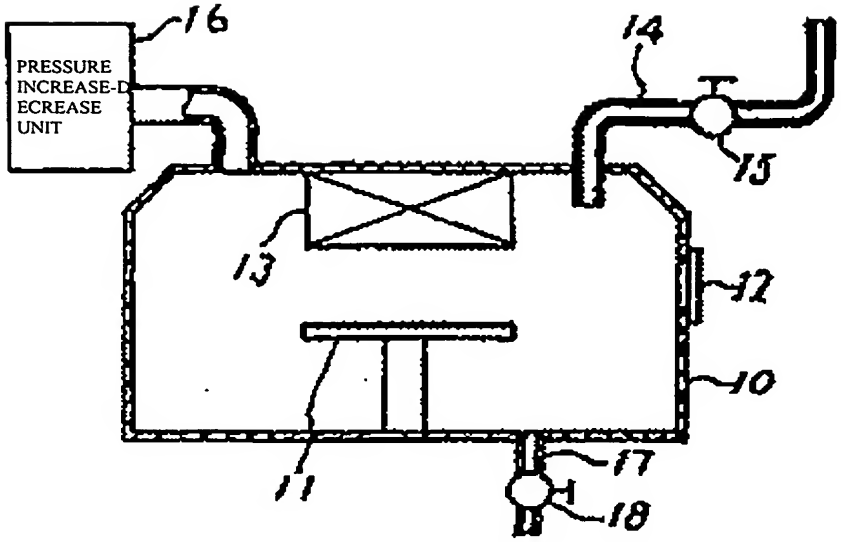
6. Contents of Amendment

The specification is corrected as follows.

Page	Line	Before amendment	After amendment

3	13	processing after edging	processing after etching
3	29	is set to circulate	is supplied during circulation
4	13-14	pressure decreasing is carried out for the cleaning tank (1)	the pressure is decreased inside the cleaning tank (1)
5	2	cleaning over the bottom	cleaning over the bottom
5	4-5	remains, resulting in the deterioration of the reliability	remains, resulting in the deterioration of the reliability of the semiconductor device
7	9	the opened state	a closed state
7	21	enters into the inside of the trenches (5)	enters into vicinities of the bottom in (5) as much as possible
7	30	conventional example	conventional example in which processing for decreasing the pressure inside the tank
8	4-5	is dispersed, whereby scattering	is taken thereinto while dispersion, and subsequently
8	6-7	By continuing this ultrasonic processing	Further, by continuing this ultrasonic processing
8	19-20	one for which improvement in quality is attempted	a semiconductor device for which improvement in quality is attempted
9	14	one for which improvement in quality is attempted	a semiconductor device for which improvement in quality is attempted
			Concluded

FIG. 1



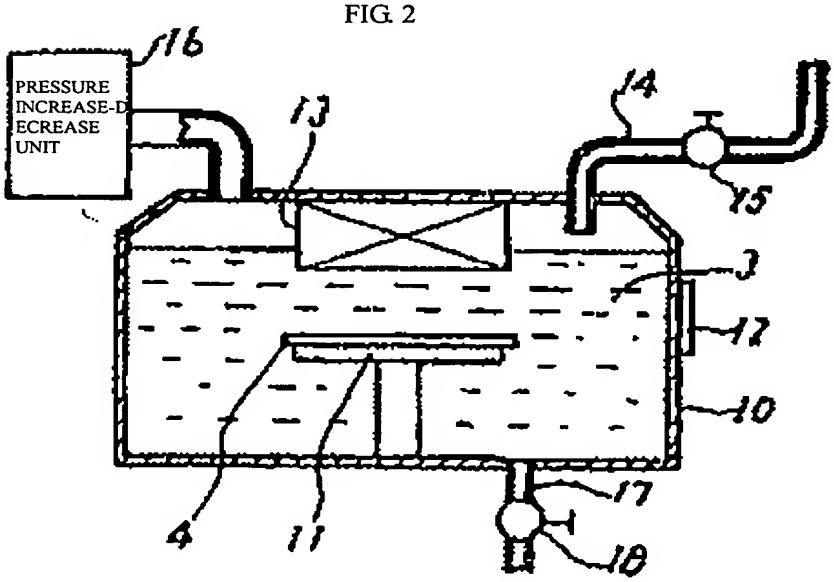
10: CLEANING TANK

13: TRANSDUCER

14: CLEANING FLUID SUPPLY PIPE

16: PRESSURE INCREASE-DECREASE UNIT

FIG. 2



3: CLEANING FLUID

4: WAFER

FIG. 3

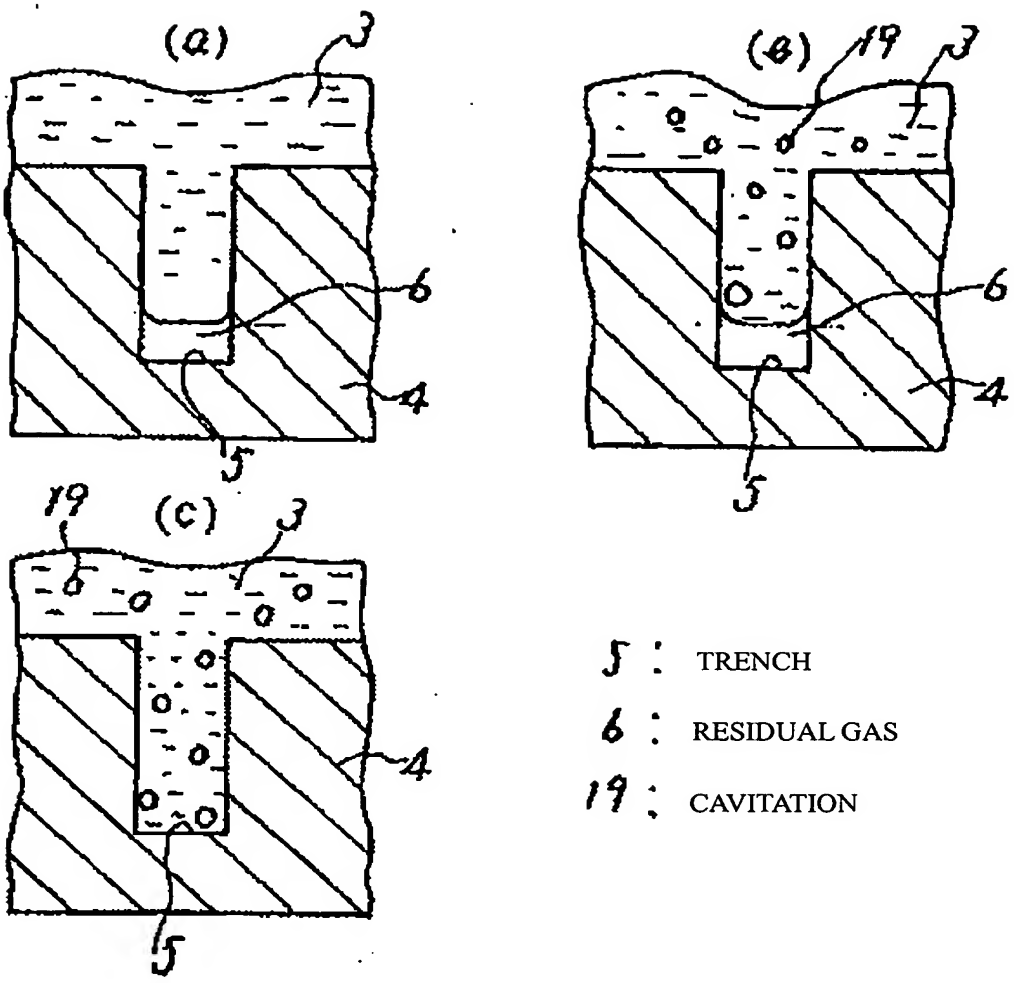


FIG. 4

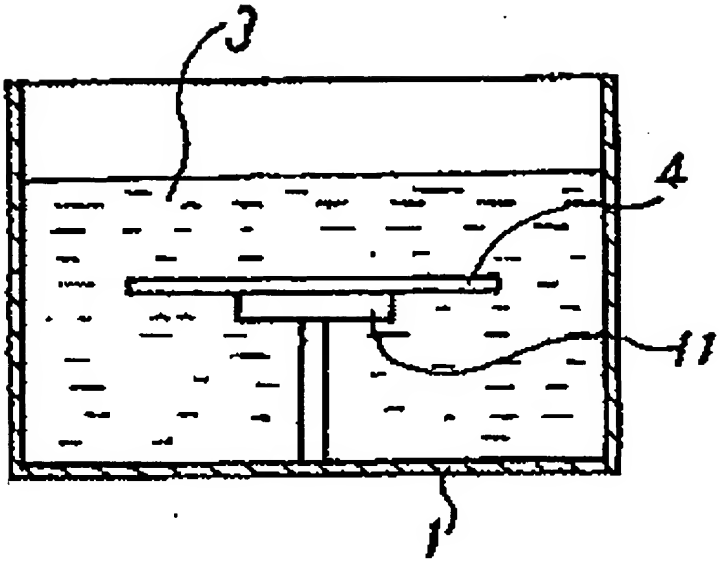
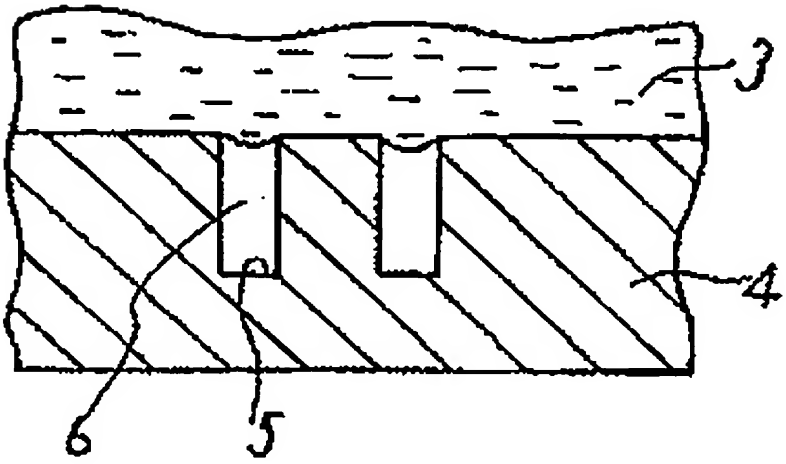


FIG. 5



⑲日本国特許庁(JP)　⑪特許出願公開

⑫公開特許公報(A)　平3−44927

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H 01 L 21/304　3 4 1 M　8831−5F

審査請求　未請求　請求項の数 2　(全5頁)

⑭発明の名称　半導体基板の洗浄方法およびそれに用いる洗浄装置

⑳特　願　平1−181025
㉒出　願　平1(1989)7月12日

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明　細　書

1. 発明の名称

半導体基板の洗浄方法およびそれに用いる洗浄装置

2. 特許請求の範囲

(1) 半導体基板が収容される処理槽内を減圧状態にし、処理槽内に洗浄液を供給して凹部が形成された前記基板が洗浄液に浸漬されるようにして、これらに超音波振動処理を加えて凹部に残留する気体を排出させることにより洗浄が行われるようにした半導体基板の洗浄方法。

(2) 半導体基板が収容されるべき密閉可能な処理槽と、この処理槽内に洗浄液を供給する洗浄液供給手段と、前記処理槽内に設けられ、前記洗浄液に超音波振動を与える超音波発生手段と、前記処理槽内を減圧あるいは加圧状態に調整する減圧加圧手段とを備えた半導体基板の洗浄装置。

3. 発明の詳細な説明

〔産業上の利用分野〕

この発明は凹部が形成された半導体基板を洗浄する半導体基板の洗浄方法およびそれに用いる洗浄装置に関するものである。

〔従来の技術〕

近年、半導体集積回路の高集積化、微細化に伴い、半導体基板(以下、単にウエハと称す)上に形成される回路パターンも微細化され、その構造も複雑になつてきている。このため、ウエハ上に凹部を形成し、その部分に素子を形成するといつた技術が採用されている。

また、高集積化、微細化が進むにつれて従来、問題にならなかつたウエハ上の付着異物等も特性上、大きな問題として顕在化するようになつた。

そのため、それらは洗浄処理によつて確実に取り除かれねばならない。前記凹部を形成する際のエッジング後の処理、あるいはウエハ上に形成された酸化物の除去処理等において洗浄処理が行われる。

第4図はこの種の従来の洗浄処理が行われる洗浄装置の概略構成を示す図である。図において、(1)は洗浄が行われる洗浄槽、(3)は洗浄槽(1)内に供

給された洗浄液、(4)は洗浄液(3)に浸漬処理されるウエハ、(0)は洗浄槽(1)内に設けられウエハ(4)を載置させるウエハ支持台である。

次に、このようにして構成される洗浄装置による洗浄方法を説明する。まず、洗浄槽(1)内に洗浄液(3)が供給され、洗浄槽(1)の所定高さの状態まで洗浄液(3)で満たす。この後、ウエハ(4)を洗浄槽(1)内に移送し、ウエハ支持台(0)上に載置する。このように洗浄液(3)中に浸漬させてウエハ(4)の処理を行う。このとき、洗浄液(3)は、通常、循環されるようになされる。このようにしてウエハ(4)の洗浄が行われるが、第5図に示すようにウエハ(4)には凹部であるトレンチ(5)が形成されている。このトレンチ(5)は、例えば、開口の平面寸法が1μm×1μmで、深さ寸法が5μm程度に形成されたものである。

ウエハ(4)の主面部は勿論、このトレンチ(5)内にわたり、洗浄が行われる必要がある。

ところで、前記循環による洗浄方法のほかに、ウエハ(4)の洗浄方法として、より洗浄効率を高めるために、洗浄液(3)およびウエハ(4)に超音波を加えたり、また洗浄液(3)を加圧したりする洗浄方法も用いられている。さらにウエハ支持台(0)上にウエハ(4)を載置させた後、洗浄槽(1)内に減圧し、その状態で洗浄液(3)を供給してウエハ(4)を洗浄する方法も用いられている。

〔発明が解決しようとする課題〕

従来の洗浄方法は以上のようであり、ウエハ(4)上に形成された開口の平面寸法が1μm×1μmで、深さ寸法が5μmという微細なトレンチ(5)内の洗浄が完全に行われないものであつた。

すなわち、第5図に示すように、トレンチ(5)が形成されたウエハ(4)に洗浄液(3)を供給しても、トレンチ(5)内には気体(6)が残留し、洗浄液(3)がトレンチ(5)内の全面にゆきわたらない。

これは、トレンチ(5)の開口幅寸法が極めて小さなために洗浄液(3)がその表面張力により、トレンチ(5)内に侵入されにくく、超音波方法、加圧、減圧方法等の洗浄方法ではトレンチ(5)内の残留気体(6)と洗浄液(3)とを置換えさせることが困難だからである。このため、従来の洗浄方法ではトレンチ(5)内の底部にわたり洗浄が行われず、異物を完全に除去することが出来ず、それらが残存し、信頼性の損われたものになつてしまうという問題点があつた。

この発明は上記のような問題点を解消するためになされたもので、ウエハ上に形成された凹部内に洗浄液がゆきわたるようにしてなされ、好適な洗浄が行われて品質の向上が図られるウエハの洗浄方法およびそれに用いる洗浄装置を得ることを目的とする。

〔課題を解決するための手段〕

この発明に係る半導体基板の洗浄方法は、基板が収容される処理槽内を減圧状態にし、処理槽内に洗浄液を供給して凹部が形成された前記基板が洗浄液に浸漬されるようにして、これらに超音波振動処理を加えて凹部に残留する気体を排出させることにより洗浄を行うようにしたものである。

また、この発明に係る半導体基板の洗浄装置は、基板が収容されるべき密閉可能な処理槽と、この処理槽内に洗浄液を供給する洗浄液供給手段と、前記処理槽内に設けられ、前記洗浄液に超音波振動を与える超音波発生手段と、前記処理槽内を減圧あるいは加圧状態に調整する減圧、加圧手段とを備えたものである。

〔作用〕

この発明において、処理槽を減圧、加圧手段により、減圧状態にして洗浄液供給手段から洗浄液を供給することにより、基板上に形成された凹部の底部近傍に洗浄液が行くようになる。さらに、その状態で超音波発生手段を動作させて、洗浄液を介して基板に超音波処理が加えられるため、凹部の底部に残留する気体が気泡となつて洗浄液中あるいは処理槽内の所定空間部に放出され、凹部内の全面にわたり洗浄液が行き渡るようになる。このようにして凹部内が洗浄液により所望状態に洗浄することができるようになる。

〔実施例〕

以下、この発明の実施例を図について説明する。第1図はこの発明の一実施例の洗浄装置の概略構

成を示す図である。図において、00は洗浄槽、01は洗浄槽00の底部に設けられたウエハ支持台、02は洗浄槽00の側部に開閉自在で、水密可能に形成された搬出入ドア、03はウエハ支持台01と対向して洗浄槽00の上部に設けられた超音波振動子（以下、振動子と称す）である。04は先端部が洗浄槽00の上部より挿通された洗浄液供給管、05は洗浄液供給管04の経路に設けられたバルブ、06は先端部が洗浄槽00の上部より挿通され、洗浄液供給管04と対向して設けられた減圧、加圧部である。07は洗浄槽00の底部に設けられた排液管、08は排液管07の経路に設けられた排液バルブである。

次に、このように構成される洗浄装置を用いてウエハ(4)を洗浄する方法について説明する。

まず、搬出入ドア02を開状態にし、処理槽00内にウエハ(4)を移送し、ウエハ支持台01にウエハ(4)を載置する。このウエハ(4)にはトレンチ(5)が形成されており、ウエハ支持台01上では、トレンチ(5)が形成された主面側が上側になるようにウエハ(2)が載置される。搬出入ドア02を開状態にした後、減圧加圧部06を作動させ、処理槽00内を所定圧に減圧する。このとき、バルブ05、排液バルブ08は閉状態となされている。この後、バルブ05を開き、洗浄液供給管04より洗浄液(3)、例えば純水を処理槽00内に供給する。この洗浄液(3)は第2図に示すように、振動子03の一部が浸漬される程度まで供給され、そこでバルブ05が閉状態となる。続いて減圧、加圧部06を作動させ、処理槽00内を大気圧まで戻す。これにより処理槽00内の空間部が減圧から加圧される状態になつて洗浄液(3)がトレンチ(5)内に入り込む。

このとき、減圧、加圧部06を作動させ、処理槽00内を10㎜Hg ～ 100㎜Hgに減圧し、大気圧（760㎜Hg）に戻すとトレンチ(5)において開口の平面寸法が1μm×1μmで、深さが5μmの場合では、残留気体(6)はトレンチ(5)の底面から約0.06～0.6μmの高さまでの容積を占めている。

この状態では、従来例に比べて残留気体(6)の容積は約1/80 ～ 1/8 程度となる。（第3図(a)）。

次に、振動子03を周波数75kHZ、出力0.2w/㎠で作動させる。これにより、洗浄液(3)内にキャビテーション09が発生する。キャビテーション09が消滅するときの衝撃波によりトレンチ(5)内の残留気体(6)が、順次、洗浄液(3)中に分裂し、飛散、拡散が起こる。（第3図(b)）。

キャビテーション09発生後、約2～3分経過するとトレンチ(5)内の気体(6)は消滅する。この超音波処理を続け、所定時間、例えば10分間行うことにより、トレンチ(5)内の側壁及び底面に付着した異物がトレンチ(5)外に拡散され、充分洗浄される。（第3図(c)）。

この後、排液バルブ08が開状態となり、排液管07から洗浄液(3)が排液される。ウエハ(4)を搬出入ドア02より洗浄槽00外に移送し、乾燥装置によりウエハ(4)を乾燥させる。

このようにウエハ(4)の洗浄処理を行えば、ウエハ(4)上に形成されたトレンチ(5)内には付着した異物の除去が効果的に行われる。このようにして洗浄処理されることにより品質の向上が図られたものを得ることができる。

なお、上記実施例では洗浄槽00内を減圧し、洗浄液(3)を供給後、大気圧にまで戻したが、洗浄槽00内に減圧し、洗浄液(3)を供給後も加圧せず減圧状態のままであつてもトレンチ(5)内の残留気体(6)の容積は、従来方法に比べて十分小さくなる。また、洗浄槽00内を減圧し、洗浄液(3)供給後、大気圧以上に加圧すればトレンチ(5)内の残留気体(6)は、洗浄液(3)供給後、大気圧にまで戻した場合に比べて、その容積をさらに小さくすることが可能である。これらいずれであつても上記一実施例と同様の効果を奏するものである。

また、上記一実施例では凹部が開口寸法1μm×1μm、深さ5μm程度のものについて説明したが、開口寸法がさらに小さく、深さがさらに大きな寸法のものについても適用され、上記と同様の効果が得られることは言うまでもない。

〔発明の効果〕

以上のようにこの発明によれば、基板が収容される処理槽内が減圧状態となされ、洗浄液を供給して基板が浸漬されるようにし、この状態で超音

波振動処理が加えられるような洗浄方法としたので、基板上に形成された凹部が充分に洗浄され、品質向上が図られたものを得ることができる。

また、基板が収容されるべき処理槽に洗浄液を供給する洗浄液供給手段を、超音波振動を与える超音波発生手段と、処理槽内を減圧あるいは加圧状態に調整する減圧、加圧手段とを備える洗浄装置としたので好適な洗浄が行われて品質向上を図ることができる効果を有する。

4. 図面の簡単な説明

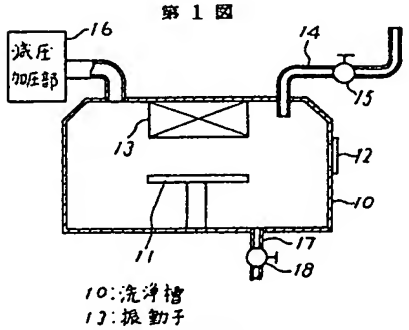
第1図はこの発明の一実施例の洗浄装置の概略構成を示す断面図、第2図は第1図に示す洗浄装置を用いて基板を洗浄する状態を示す断面図、第3図(a)～(c)はこの発明の洗浄方法により基板の要部であるトレンチ部が洗浄される過程を示す要部断面図、第4図は従来の洗浄装置を用いて基板を洗浄する状態を示す断面図、第5図は第4図に示すものにより基板のトレンチ部が洗浄される状態を示す要部断面図である。

図において、(3)は洗浄液、(4)はウエハ、(5)はトレンチ、(6)は残留気体、10は洗浄槽、13は振動子、14は洗浄液供給管、16は減圧、加圧部、19はキャビテーションである。

なお、図中、同一符号は同一、または相当部分を示す。

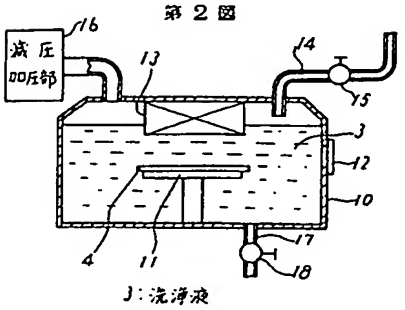
代理人　大岩増雄

第1図



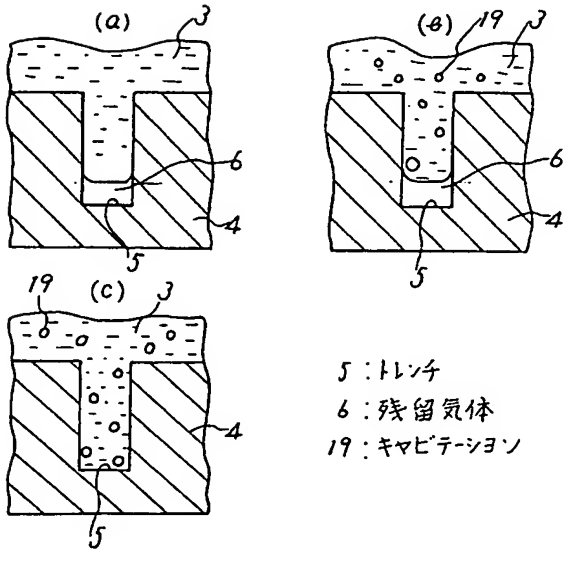
10:洗浄槽
13:振動子
14:洗浄液供給管
16:減圧加圧部

第2図



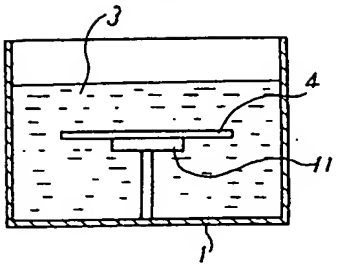
3:洗浄液
4:ウエハ

第3図

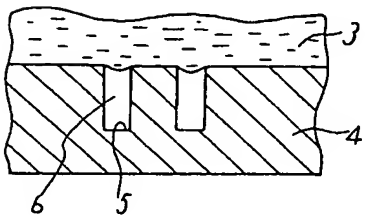


5:トレンチ
6:残留気体
19:キャビテーション

第４図



第５図



手　続　補　正　書（自発）

平成 2 年 1 月 22 日

特許庁長官殿

1．事件の表示　　特願平 1－181025 号

2．発明の名称

半導体基板の洗浄方法およびそれに用いる洗浄装置

3．補正をする者

事件との関係　特許出願人
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4．代　理　人

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(連絡先03(213)3421特許部)

5．補正の対象
明細書の発明の詳細な説明の欄

6．補正の内容
明細書をつぎのとおり訂正する。

ページ	行	訂　正　前	訂　正　後
2	15	エッジング後の処理	エッチング後の処理
3	10～11	循環されるようになされる。	循環供給される。
4	4	洗浄槽(1)内に減圧し、	洗浄槽(1)内を減圧し、
5	2	底部にわたり洗浄	底部にわたる洗浄
5	3～4	残存し、信頼性の	残存し、半導体素子の信頼性の
7	20	開状態	閉状態
8	11	(6)内に入り込む。	(6)内底部の極めて近傍まで入り込む。
8	18	従来例に	容器内減圧過程を含まない従来例に
9	4	分裂し、飛散、	分散しながら取り込まれ、続いて
9	7～8	この超音波処理を続け、	さらにこの超音波処理を続け、
9	19～20	図られたものを	図られた半導体素子を
11	3	図られたものを	図られた半導体素子を

以　上